April 17, 1934. J. S. FASTING 1,955,277

APPARATUS FOR PRELIMINARY TREATMENT OF RAW MATERIAL MIXED FOR CEMENT BURNING

Filed April 28, 1931 4 Sheets-Sheet 1

Fig. 1

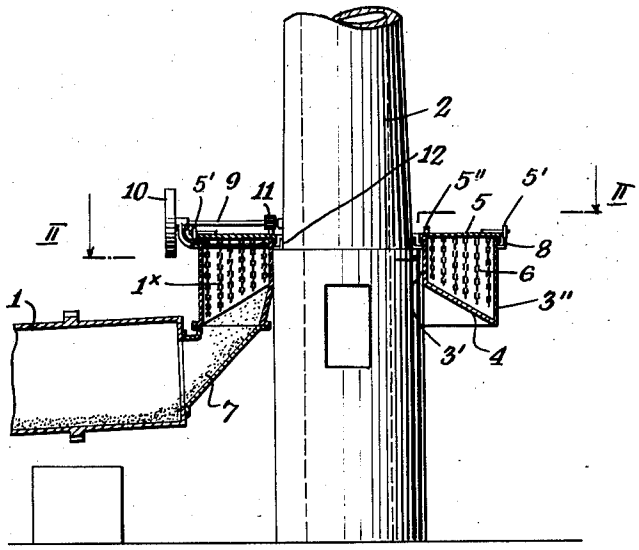

Fig. 2

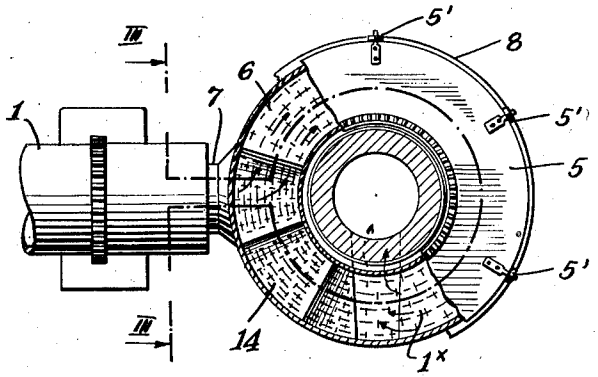

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Fig. 3

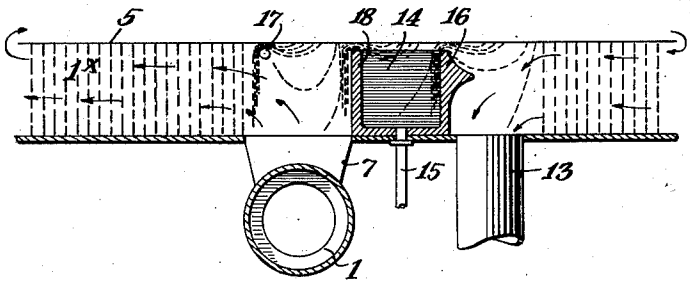

Fig. 4

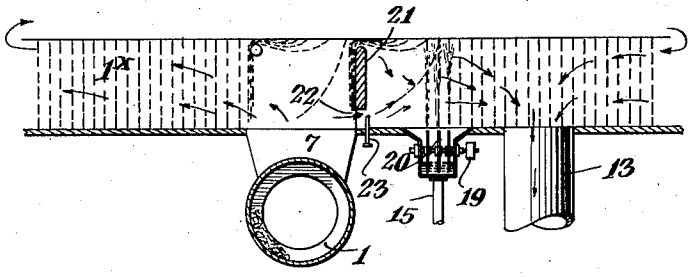

Fig. 5

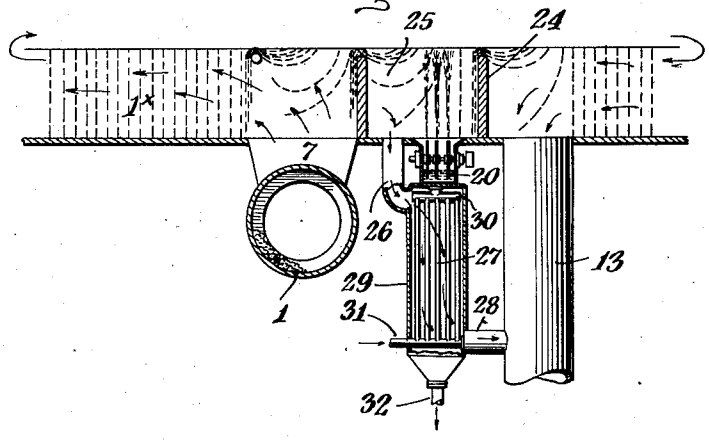

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Fig. 6

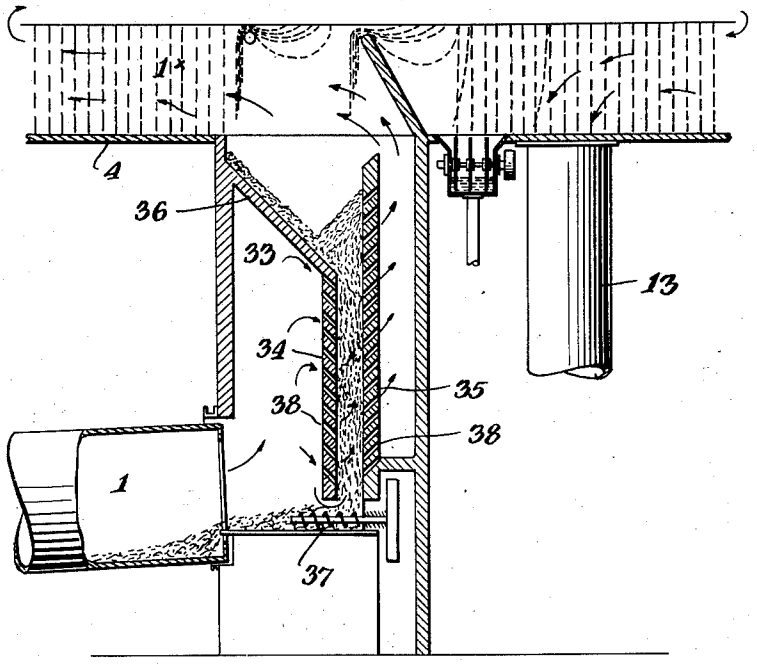

Fig. 7

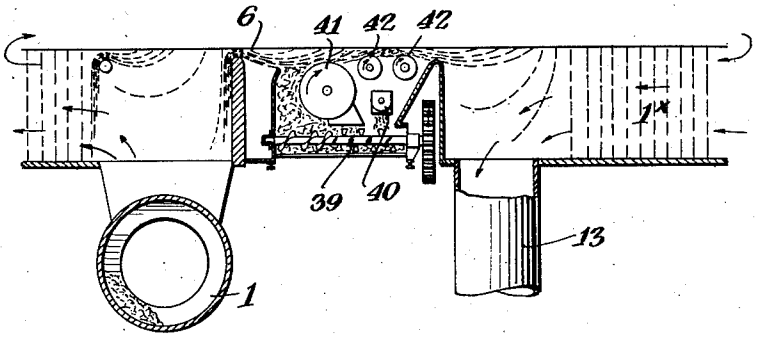

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Fig. 8

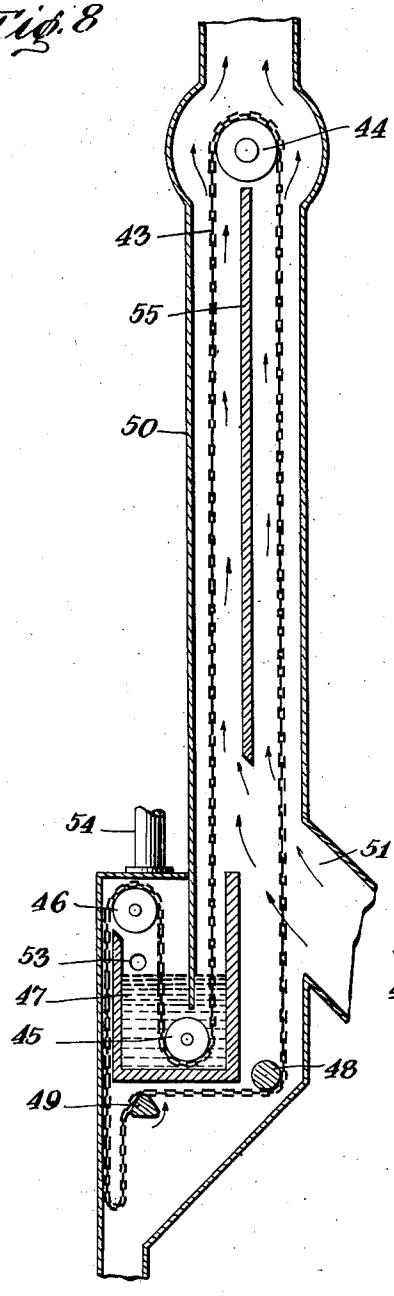
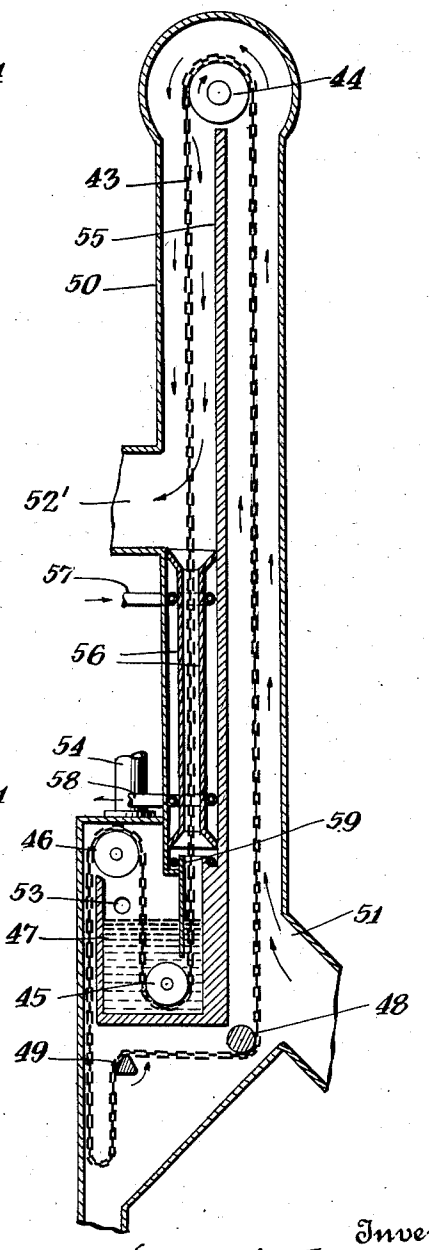


Fig. 9



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Patented Apr. 17, 1934 1,955,277

UNITED STATES PATENT OFFICE

1,955,277

APPARATUS FOR PRELIMINARY TREATMENT OF RAW MATERIAL MIXED FOR CEMENT BURNING

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Application April 28, 1931, Serial No. 533,463
In Great Britain July 24, 1930

1 Claim. (Cl. 222—7)

Various attempts have been made to reduce the operating costs of burning cement and similar materials in rotary kilns, especially by causing the combustion gases produced in the kiln to come into intimate contact with the material passing through the kiln. With this end in view there have been placed in the upper portion or drying zone of kilns used in the wet process, chains or other bodies of relatively large surface area, such bodies serving to collect on their surface a thin layer of raw slurry, so that the transfer of heat from the combustion gases to the slurry will be furthered in consequence of the large surface of slurry thus produced and exposed to the combustion gases. A limit is soon reached, however, for the extent to which the heat transferring means can be used in this manner, as such bodies will reduce the cross-sectional area of the kiln available for passage of the combustion gases and the raw material, and impede such passage.

The present invention has for its object to utilize, to a far greater extent than heretofore possible, the method of heat transfer from the combustion gases to the slurry by allowing the raw slurry to form a coating on carrier bodies which coating is dried and preheated by the heat from combustion gases flowing past the said bodies and by radiant heat from the walls of the chamber where such action takes place, and, it may be, also by heat previously absorbed by such carrier bodies.

In accordance with this invention the formation of the coating of slurry on the carrier bodies (chains or other suitable metallic bodies) is effected outside of the kiln, the carrier bodies being thereafter or at the same time caused to pass through a drying chamber through which pass also the combustion gases, and being finally freed from their dried and, it may be, also preheated coating of slurry, which is then conveyed to the kiln or other suitable furnace.

The formation of the coating of slurry on the carrier bodies may be effected in a portion of the same drying chamber through which the carrier bodies pass, and the subsequent release of the dried coating of slurry from the carrier bodies may be effected at some suitable point of the chamber. The slurry may be applied to the carrier bodies in various ways, as by immersion of the carrier bodies into the slurry, or the spraying of the slurry on the carrier bodies in liquid state, or by pressing the slurry on the carrier bodies in a plastic state, and various mechanical devices may be used for these purposes.

By such drying and preheating of the slurry before it enters the kiln several advantages can be realized that could not be realized by the arrangement of chains or the like in the drying zone of a rotary kiln. By the arrangement here referred to the bodies carrying the slurry can be disposed in such a manner that the coating of slurry adhering thereto will not be exposed to the risk of being scraped away before it is entirely dry, as would be the case in a rotary kiln. The free cross-sectional area of the slurry-drying chamber may further, independently of the cross-section of the kiln, be made as large as desired, i. e. so large that the number of carrier bodies may be as great as required for attaining the requisite superficial area for the slurry, without thereby creating any excessive resistance to the passage of combustion gases through the chamber. At the same time all difficulties in conveying the slurry through the drying region will be obviated, because the material passes through this region while clinging to the carrier bodies.

Several embodiments of the invention are illustrated in the drawings, in which:

Figure 1 is a view in sectional elevation showing a portion of a rotary kiln with the slurry drying means in operative relation therewith.

Figure 2 is a view in horizontal section on the irregular plane indicated by the line II—II of Fig. 1.

Figure 3 is a developed vertical circular section along the line III—III of Fig. 2.

Figures 4 and 5 are two corresponding developed vertical circular sections showing modified devices for applying the slurry to the carrier bodies or chains.

Figure 6 is a view in vertical section of another embodiment of the invention in which the heating chamber, formed to some extent like a shaft furnace or vertical kiln, is interposed between the drying chamber and a rotary kiln.

Figure 7 is a developed vertical circular section corresponding to those shown in Figs. 3, 4 and 5 but with a modified means for applying the slurry to the carrier bodies, and

Figures 8 and 9 are views in vertical sections of two other modifications in which endless chains running on rollers are used as carrier bodies for the slurry.

In the embodiment of the invention shown in Figs. 1, 2 and 3 the slurry-drying chamber 1^x is formed as an annular channel which communicates with a rotary kiln 1 and encircles the stack 2, although it might be wholly outside of the

stack. The chamber has fixed side walls 3' and 3'' and a bottom 4 sloping outward, while the annular cover 5 which supports the carrier bodies, here shown as chains 6, is arranged to rotate about the axis of the chamber. The chamber communicates with the rotary kiln by way of a closed channel 7 extending from the bottom of the chamber to the kiln. This channel serves partly to convey the combustion gases from the kiln to the drying chamber and partly to convey the dried raw material from the chamber to the rotary kiln. The cover 5 is supported by wheels 5^1 on a projecting flange 8 on the upper edge of the outer wall 3'', and is rotated slowly by suitable means such as a driving shaft 9 with pulley 10 and a pinion 11 engaging a corresponding circular rack 5'' on the cover. Air seals 12 are provided along both edges of the cover. The chamber communicates with the stack by way of a flue 13, Fig. 3. The path of the combustion gases is indicated by arrows in Fig. 3.

A part of the chamber is formed as or supports a tank 14, Figs. 2 and 3, which may be kept filled with raw slurry supplied by way of a pipe 15 entering the tank at its bottom. As shown in Fig. 3 the chains 6, as they are drawn over this tank 14 with the cover 5, will sink down into the raw slurry and become coated with a layer of the slurry, and will then be drawn over the right-hand side wall 16 of the tank and then once more assume their hanging position. After having thus passed through the chamber the chains strike a rod or roller 17 disposed slightly below the cover of the chamber channel, a little to the left of the tank 14, Fig. 3, and above the channel 7 through which the dried slurry is discharged into the rotary kiln. As the chains are drawn over the rod or roller 17 they are gradually raised towards the cover, and when, in their continued passage, they leave the rod or roller 17 their movement and their impact against the wall 18 of the tank 14, will free them from the now dried slurry which will drop through the channel 7 and down into the rotary kiln.

The cover 5 preferably moves in a direction opposite to that of the combustion gases, and the drying will, therefore, be effected in counterstream.

Instead of a stack to produce the requisite draft other draft-creating means may be used, such as a fan.

The construction shown in Fig. 4 differs from that shown in Figs. 1 and 3 only in respect of the modified means for coating the carrier bodies 6 with slurry. Here the slurry is in fact thrown or sprayed up against the carrier bodies by means of a number of discs 20 rotating rapidly with a horizontal shaft 19 and situated above the slurry-supplying pipe 15, in such a manner that they dip constantly into the slurry.

It may be desirable to draw part of the hot combustion gases directly from the rotary kiln 1 to the stack 2 at the point where the slurry is thus supplied in the form of spray, and where the cross-section of the channel is filled with fine drops of slurry, as the conditions for a thorough transfer of heat from the combustion gases to the slurry are especially favorable at this point where the exposed surface area of the slurry in fine drops is considerable. In order to enable combustion gases to be supplied directly from the rotary kiln, by way of the smoke flue 7 of the latter, to such part of the drying chamber an aperture 22 with gate 23 is provided at bottom of a partition 21 in the drying chamber, in such a manner that the quantity of combustion gases used can be regulated.

In the embodiment shown in Fig. 5 the construction is such as to increase the utilization of the heat. In the spraying of slurry on to the highly heated parts a liberal generation of steam will be effected, and in the constructions shown in Figs. 1, 2, 3 and 4 such steam is permitted to escape directly to the stack, whereby the latent heat contained in the steam will be wasted. In order that this heat may be utilized the following provision is made in the construction shown in Fig. 5. The drying chamber is fitted with a transverse partition 24 separating from the rest of the chamber the part where the spraying of the slurry takes place. The thus separated part 25 of the chamber communicates with the discharge flue 13 for the combustion gases from the drying chamber to the stack by way of a duct 26 and a heat-exchanging member 27 and duct 28 at the opposite end of such member. The heat-exchanging member is also traversed by the slurry, and in the construction shown it is assumed to be formed by a cylinder 29 with vertical pipes therein and interconnected at top by one or more transverse pipes 30 terminating at the slurry spraying chamber, and at the bottom by one or more similar pipes communicating with the slurry-supply pipe 31. The slurry will thus pass through said pipes in upward direction, and the same pipes will be swept in downward direction by the steam generated in chamber 25. The steam will be condensed while giving off its latent heat, and the water of condensation escapes by way of a pipe 32 at the bottom of the heat-exchanging member.

As mentioned above the preliminary drying devices may be used not only in connection with a rotary kiln but also in connection with a shaft furnace or vertical kiln or the like.

Fig. 6 shows such an arrangement in connection with a shaft furnace. The slurry is here applied to the carrier bodies by spraying as in Fig. 4, but a connecting flue 33 in shape of a shaft furnace is interposed between the drying chamber 4 and the rotary kiln 1. This flue is formed with two vertical walls 34 and 35, the wall 34 being joined to the bottom 4 of the drying chamber by means of an inclined plane 36, in such a manner that all the dried material dropping down from the carrier bodies must pass through the space between the two walls, at the lower edge of which the material is conveyed into the rotary kiln by means of a conveyor worm 37. The walls 34 and 35 are fitted with downward sloping passages 38 for the combustion gases escaping from the rotary kiln to the drying chamber, and the descending dried raw material is therefore exposed to intense heating between the walls. As mentioned above, however, the burning proper is preferably effected in the rotary kiln 1, as a furnace of this construction produces a more uniform burning than does a shaft furnace. This rotary kiln, however, can be relatively short in comparison with ordinary rotary kilns, in which also the drying or in any case the preheating of the raw material must be effected. The remaining function of the rotary kiln will then be to take care of the last part of the thermic treatment of the raw material, mainly the calcination and the burning.

The embodiment shown in Fig. 7 is intended for use in cases where the raw material is worked according to the wet method, i. e. in the shape of raw meal. In this construction the raw material is moistened in one compartment of the drying chamber, between the supply and the

discharge flue for the combustion gases, by means of a worm 39 disposed there and serving to mix and moisten the raw meal with water supplied by sprinkling from a water pipe 40. Above this worm 39 there is provided a roller or drum 41 conveying the moistened raw material up to the carrier bodies 6 and pressing it against the same, while they are passing along over the drum. During their passage through this part of the drying chamber the carrier bodies are supported by guide rolls 42 provided just below the cover of said chamber. Instead of a drum other means for applying the moistened raw meal may be used.

In the embodiment illustrated in Fig. 8 the slurry-carriers are endless chains 43 placed side by side and running over a driving roll or roller 44 disposed at the top and guide rolls or rollers 45, 46 disposed at the bottom, one of these being located just above the bottom of a slurry tank 47 and the other above the surface of the slurry contained therein. The chains run further about a guide roll or roller 48 outside of the slurry tank and over a non-cylindrical or eccentrically disposed rotary member 49 below the slurry tank. The chains 43, the rolls or rollers 44, 45, 46, 48 as well as the member 49 and the slurry tank 47 are all enclosed in a casing 50 with an inlet 51 for the combustion gases, which pass through the casing in the direction of the arrows, and with an outlet 52 for the gases and for the steam generated from the slurry in the casing, and with a supply pipe 53 for the slurry and a discharge pipe 54 for the steam generated by the passage, through the slurry bath, of the intensely heated chains. Within the casing is disposed a partition 55 which absorbs heat from the combustion gases and by radiation transfers this heat to the chains and the slurry adhering thereto. The slurry dried on the chains will be dislodged from the chains by the vibrations caused by the rotary member 49, and will drop out through the bottom of the casing. The steam which escapes at a high temperature by way of the discharge pipe 54 may be utilized for various purposes, as for pre-heating the slurry introduced into the slurry tank.

In the embodiment illustrated in Fig. 9 the same principal arrangement will be found as that shown in Fig. 8, but with the addition of a special device for freeing the slurry coating, on the lower portions of the chain as they leave the slurry tank, from a considerable part of its water by utilization of the heat contained in the chains and the slurry coating itself. The heat of the combustion gases will thereby be conserved for evaporation of the remnant of water left in the slurry. On account of the lowered temperature of the chains after utilization of their own heat, the heat of the combustion gases can be utilized down to a lower degree of temperature than by the arrangement shown in Fig. 8. In the arrangement shown in Fig. 9 there are provided, inside of the casing 50 and outside of the lower portion of the said chains, two cooling plates 56, which are constantly sprinkled with cooling water from a supply pipe 57, the said cooling water escaping by way of a discharge pipe 58. The space between the cooling surfaces, between which the chains ascend, is fitted with a discharge pipe 59 for the water that is given off as steam from the chains and is condensed on the opposing faces of the cooling surfaces.

The outlet 52' for the combustion gases is here situated about midway on one side wall of the casing, and the partition 55 inserted in the casing extends all the way down to the slurry tank, so that the combustion gases first sweep up along one side of the partition 55 and then down along the other side. By this arrangement a better utilization of the heat of the combustion gases leaving the kiln can be realized than by the arrangement shown in Fig. 8, and the combustion gases escaping from the casing by way of the outlet 52' will also contain considerably less water, a substantial part of the water being removed between the cooling surfaces 56.

I claim as my invention:

The combintion with a kiln for the burning of cement raw material of apparatus for treating cement raw material preliminary to its introduction into the kiln, which comprises a chamber, including a tank, means to supply liquid raw material to the tank, a series of carrier bodies, means to move the carrier bodies through the chamber and the tank, means to direct the combustion gases from the kiln into said chamber, means to separate the dried raw material from the carrier bodies and means to discharge the separated material into the kiln.

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